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Kume et al.

[11] **4,194,351**

[45] **Mar. 25, 1980**

[54] **ELECTRONIC TIMEPIECE**

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[73] Assignee: **Citizen Watch Co., Ltd.,** Tokyo, Japan

[21] Appl. No.: **853,864**

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[30] **Foreign Application Priority Data**

Nov. 26, 1976 [JP] Japan 51-141174

[51] **Int. Cl.**[2] **G04C 3/00**

[52] **U.S. Cl.** **368/82;** 368/204; 368/88; 368/286

[58] **Field of Search** ..... 58/23 R, 23 BA, 50 R, 58/53, 54, 55, 56, 88 R, 88 G

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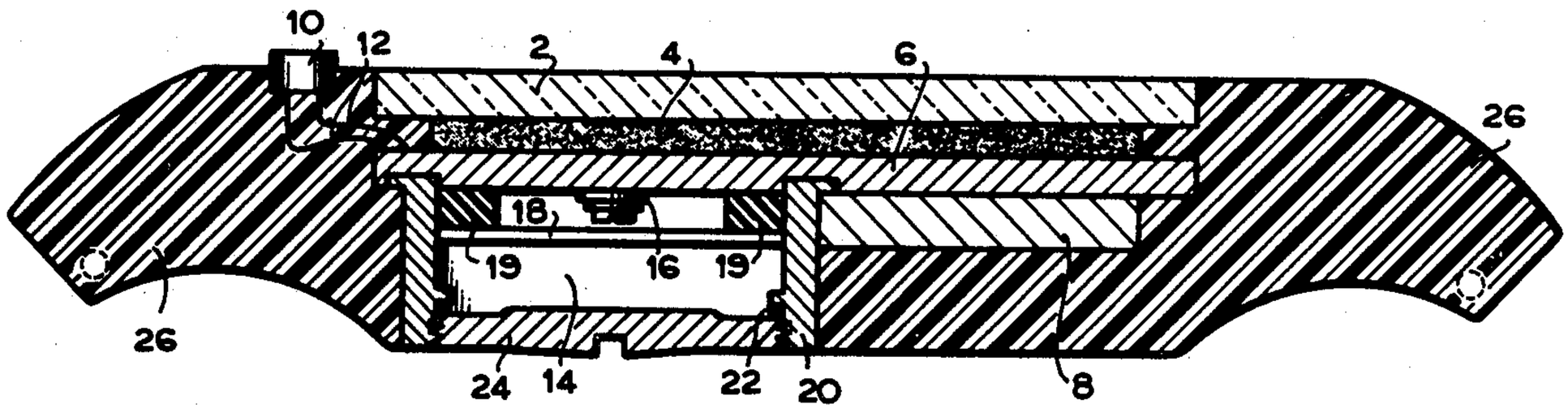
Primary Examiner—Ulysses Weldon
Attorney, Agent, or Firm—Sherman & Shalloway

[57] **ABSTRACT**

An electronic timepiece having a molded casing made of resin for incorporating in one body, timepiece components including a windshield, display means including an electro-optical display element or pointers, timepiece driving means, battery cell case and external switch means.

7 Claims, 11 Drawing Figures



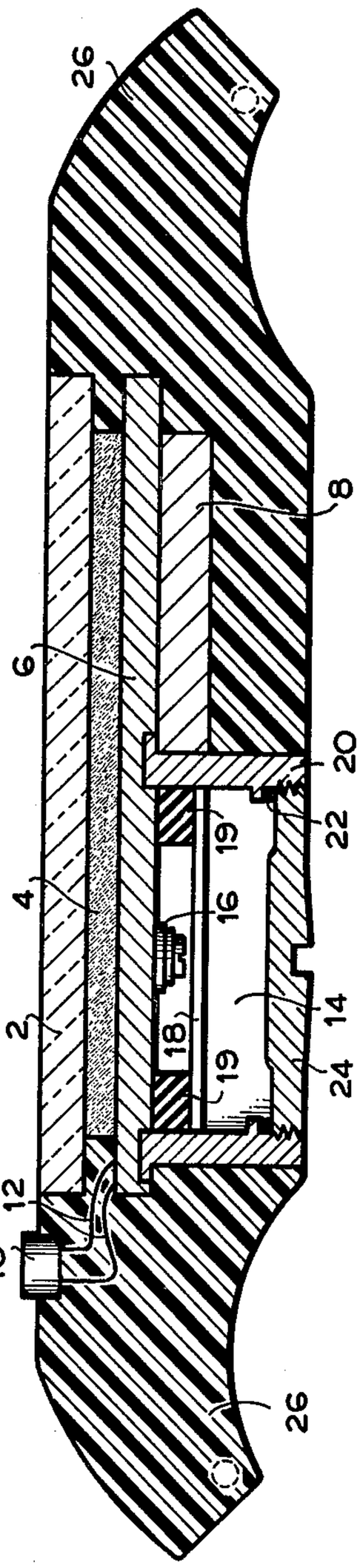
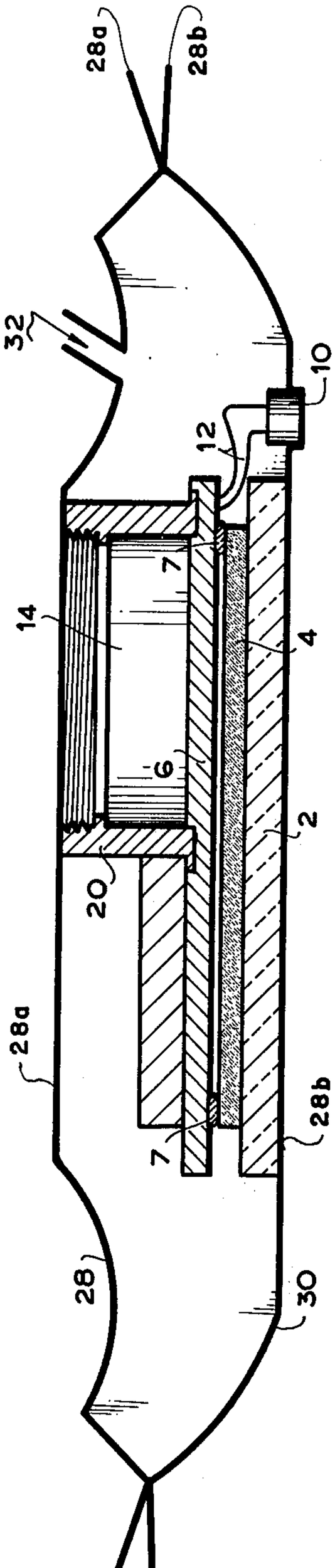

26
8
6
20
22
19
16
4
18
19
14
24
2
12
10
26

FIG. 1


28a
28b
32
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14
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6
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28a
28b
7
28
30

FIG. 2

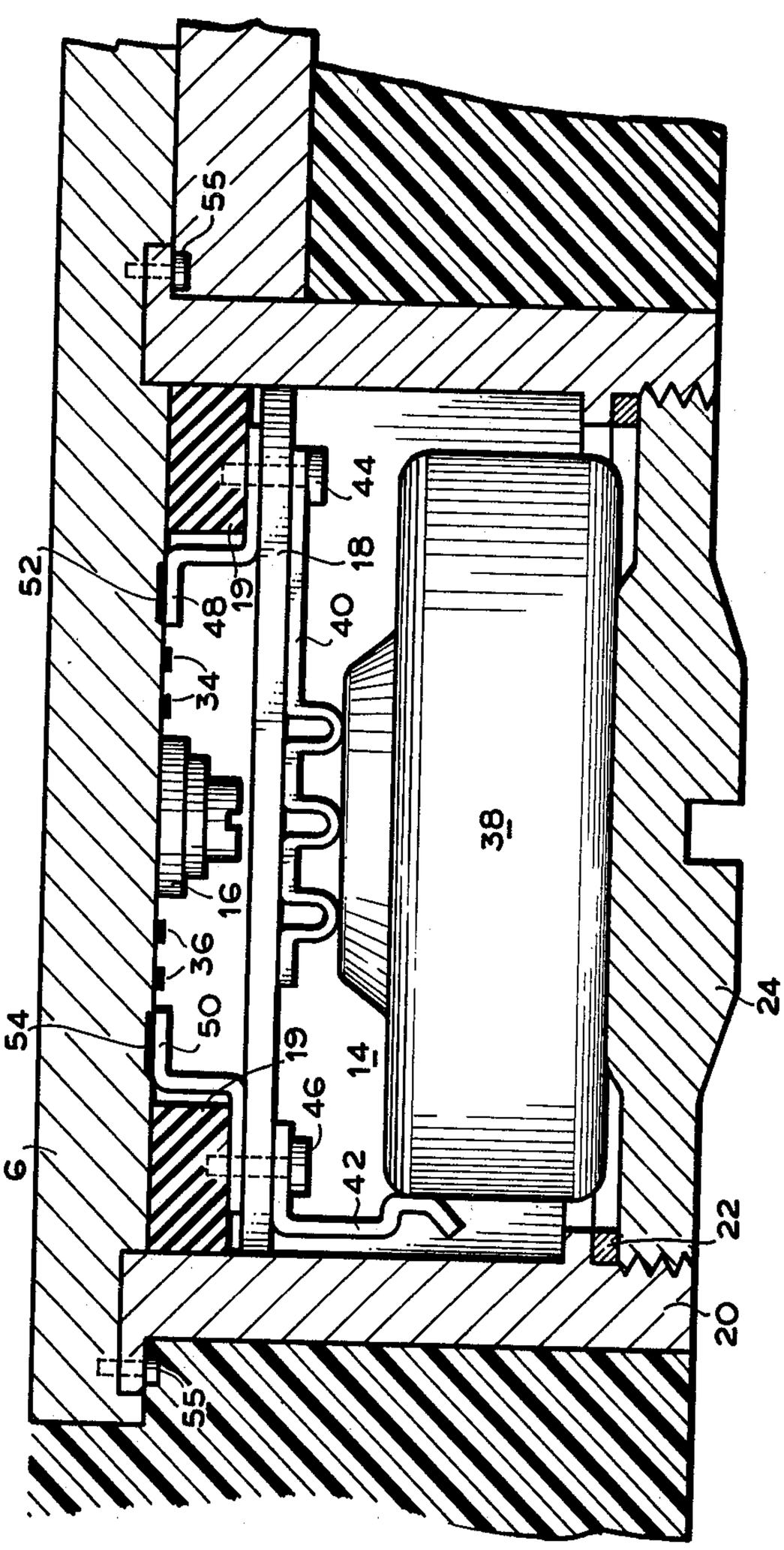

FIG. 3

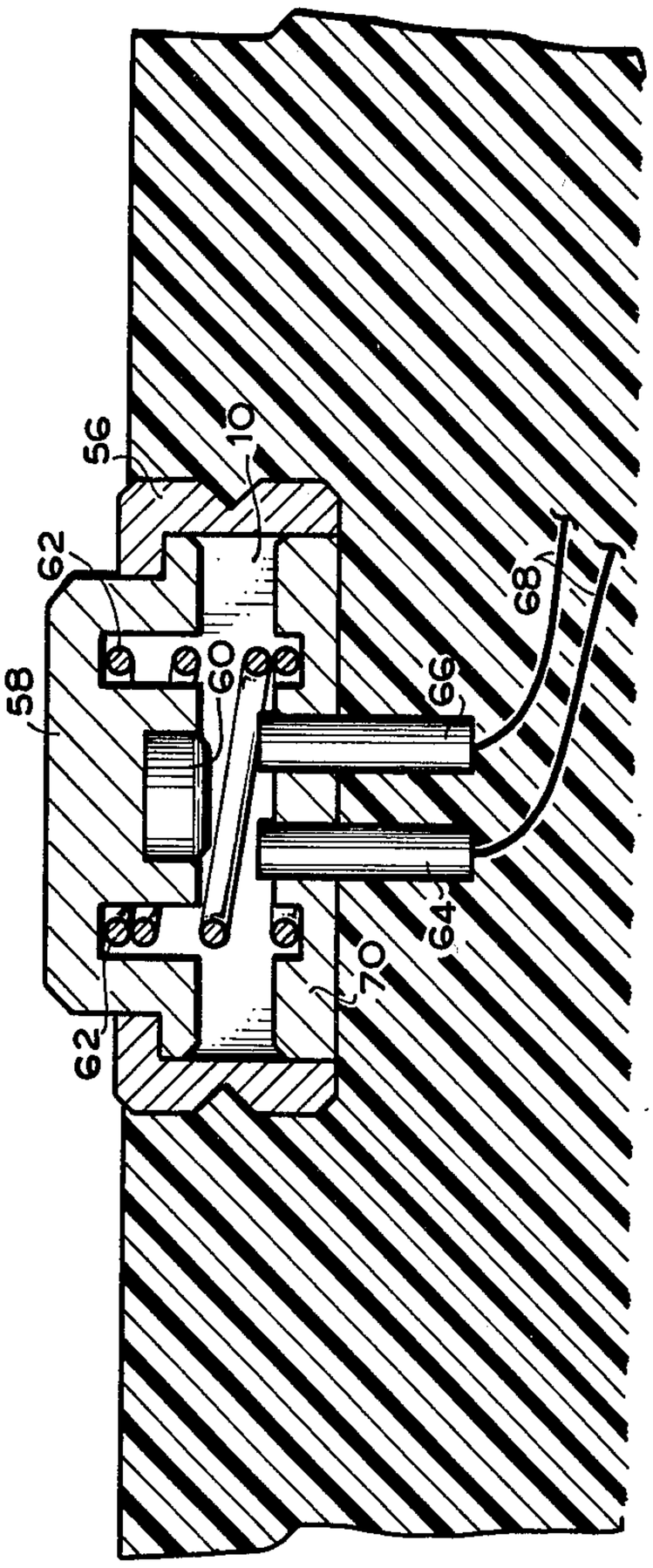

FIG. 4

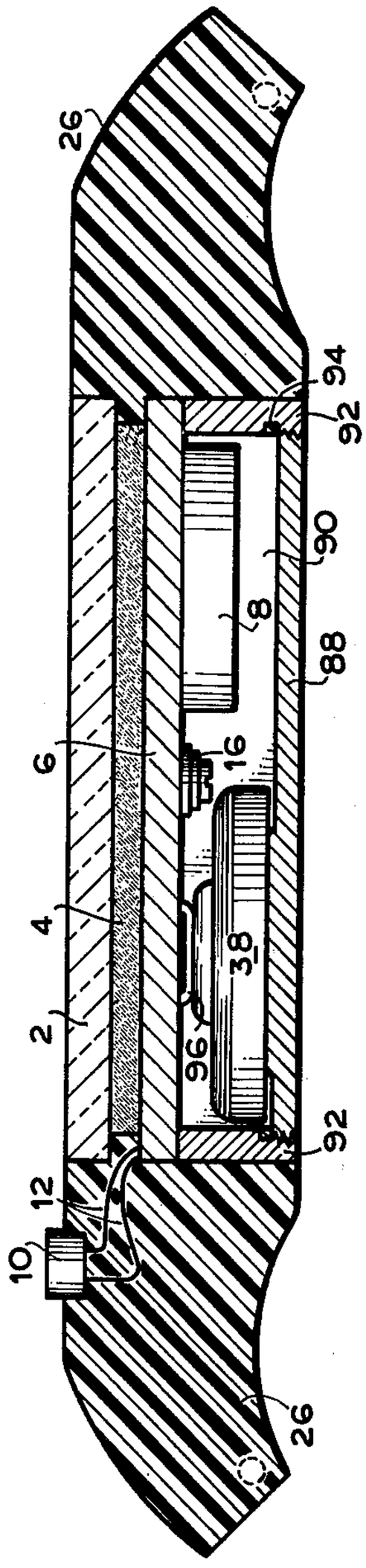

FIG. 7

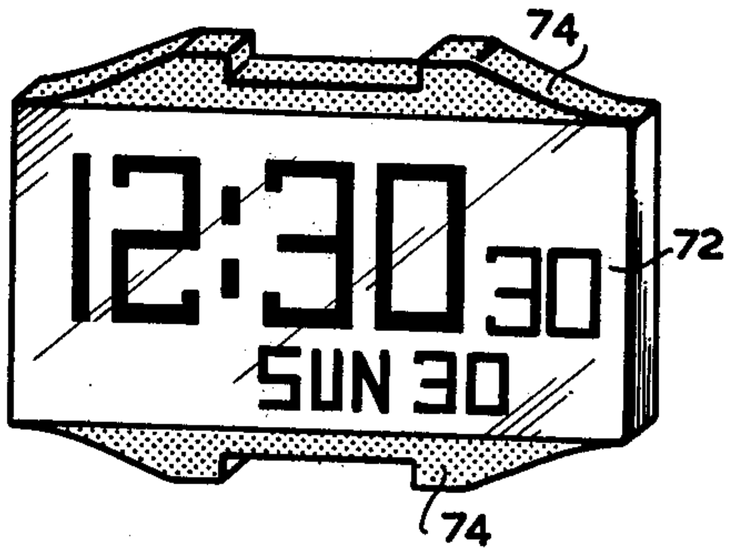

FIG. 5A

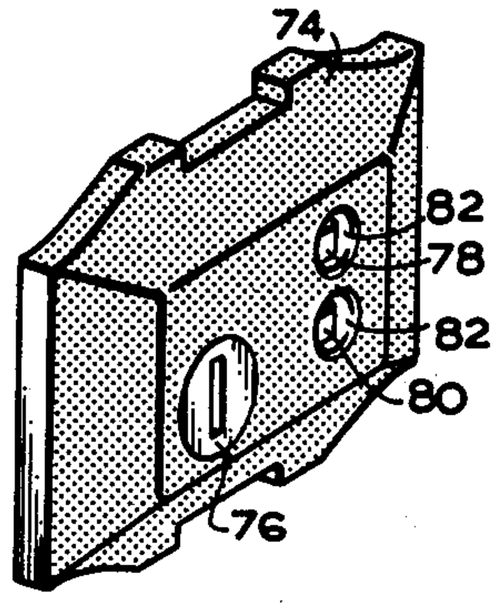

FIG. 5B

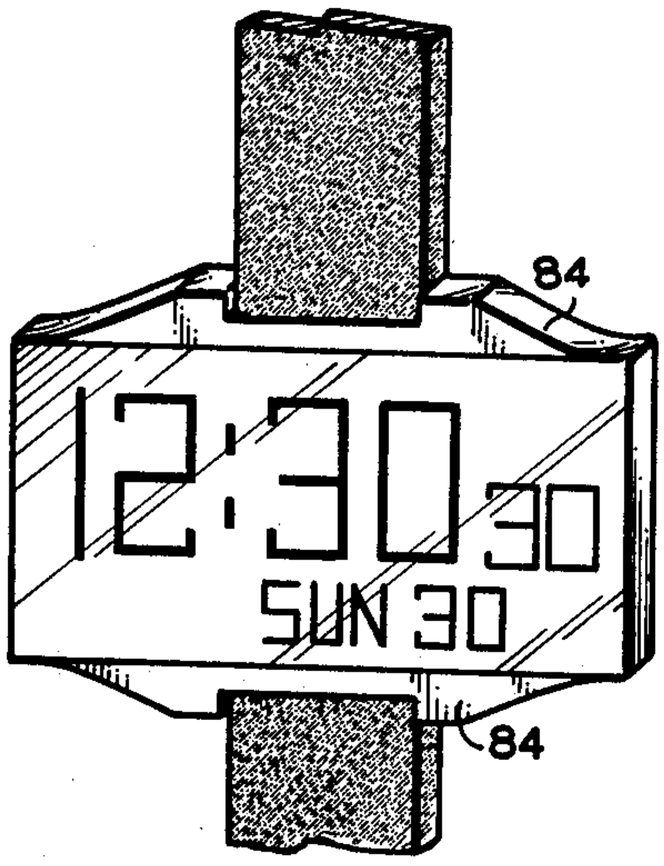

FIG. 5c

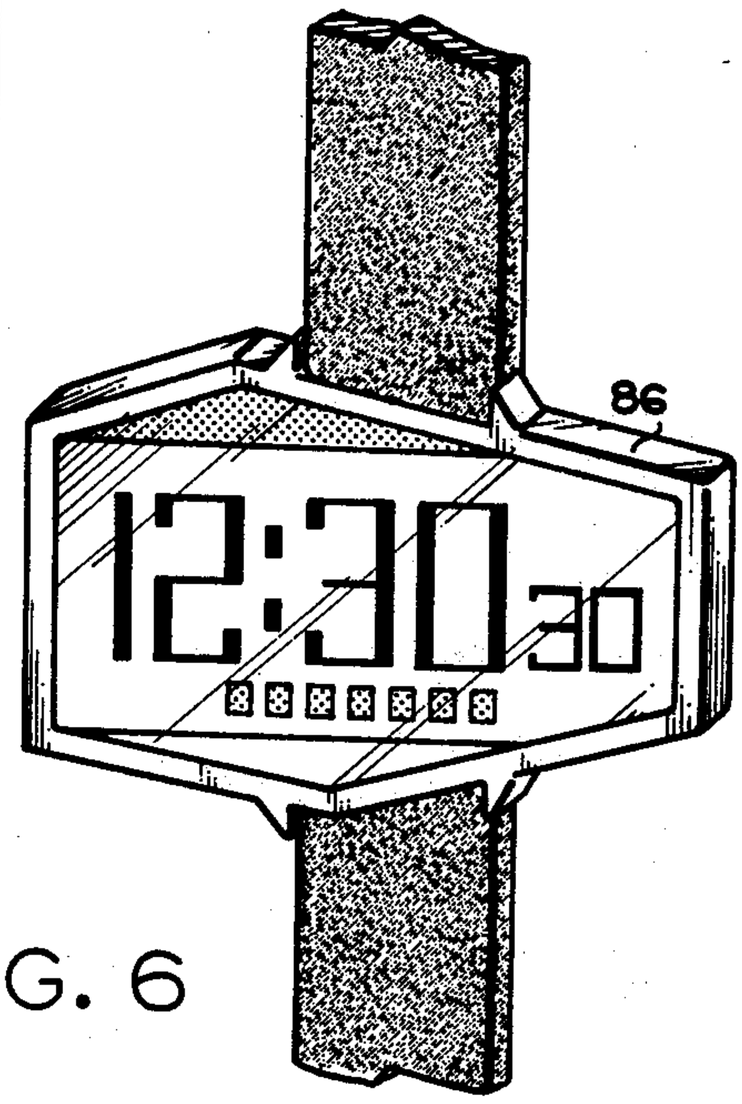

FIG. 6

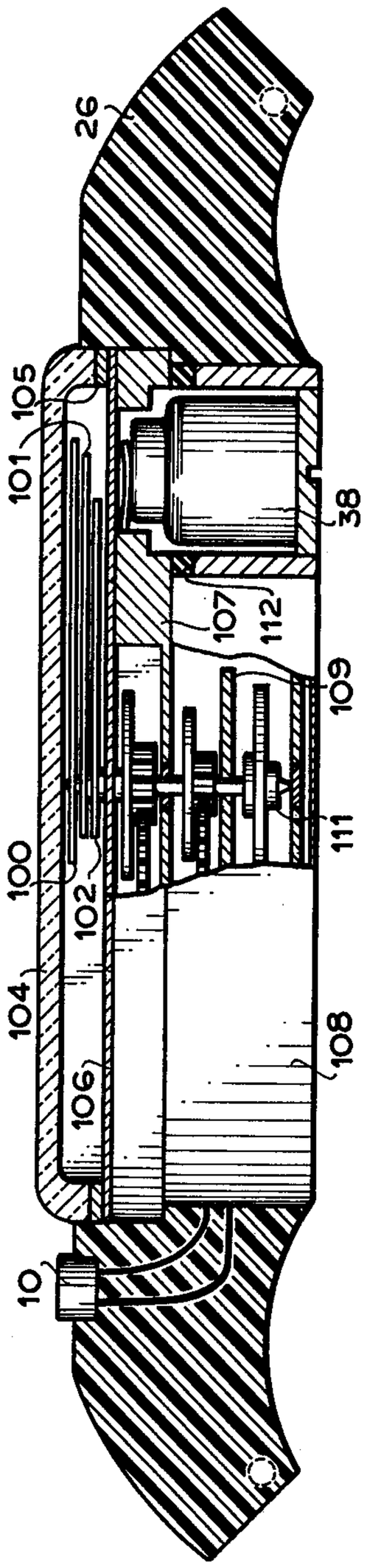
26
105
101
38
107
112
109
111
100
102
104
108
106
10

FIG. 8

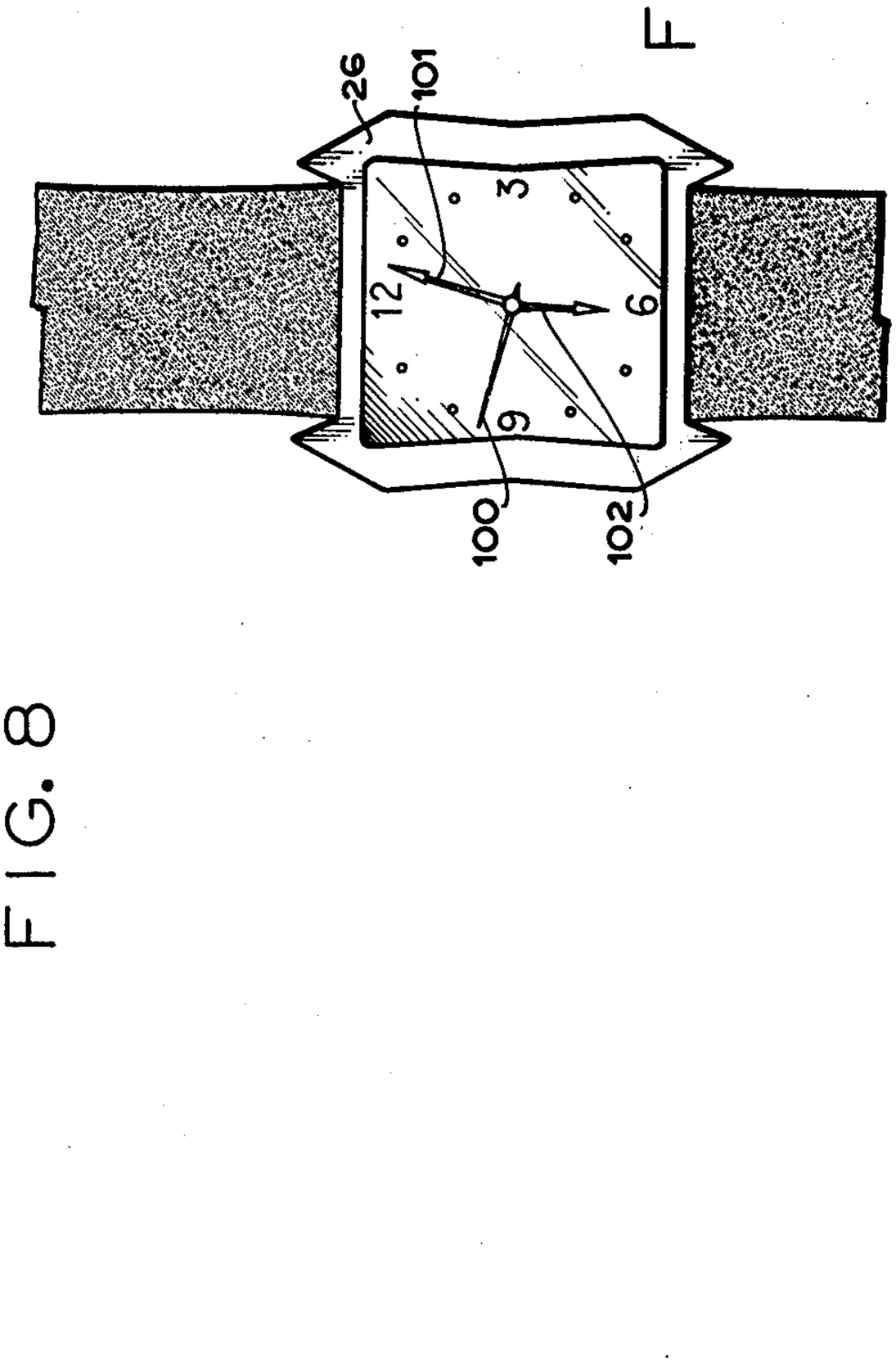
26
101
3
12
6
9
100
102

FIG. 9

ELECTRONIC TIMEPIECE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an electronic timepiece, particularly to a timepiece provided with a molded watch casing made of resin and incorporating a windshield, a display element and other timepiece composing parts in one.

2. Description of the Prior Art

Recently components of electronic timepieces, e.g. integrated circuits, crystal oscillating elements have been mass-produced to be low in cost. Assembly of these components has been extremely simplified. However in assembling the conventional electronic timepiece there are required a plate as a base plate, a bridge, a tap, a screw etc. which are not concerned with essential timepiece functions due to screw, bonding etc. for integration of the timepiece components. Therefore the number of timepiece components is increased, structures of the plate and bridge are made complicate, and its productivity is not good because of trouble in assembly.

Further the prior art watch case of the electronic timepiece is very expensive as compared with other components and its design has a large limitation.

SUMMARY OF THE INVENTION

A primary object of this invention is to provide an electronic timepiece which obviates the conventional shortcomings set forth above.

Another object of this invention is to provide an electronic timepiece which may be easily assembled and is good in its productivity.

Other object of this invention is to provide an electronic timepiece which is low in cost because of mass-production and reduction of the number of timepiece components.

Further other object of this invention is to provide an electronic timepiece which is thin in thickness and excellent in design.

According to one aspect of this invention provision is made of an electronic timepiece comprising a windshield, a display element, timepiece driving means including a time reference signal source for driving the display element, a power supply source supplying the timepiece driving means with driving energy, external switch means for externally controlling said timepiece driving means, and a molded casing made of resin and incorporating in one the windshield, the display element, the timepiece driving means and the external switch means.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a vertical section showing one embodiment of an electro-optical type electronic timepiece according to this invention;

FIG. **2** is an explanatory diagram showing manufacture method of the electronic timepiece as shown in FIG. **1**;

FIG. **3** is an amplified view of a battery cell receiving chamber as shown in FIG. **1**;

FIG. **4** is an amplified view of a switch actuating member as shown in FIG. **1**;

FIGS. **5A** to **5C** are perspective views showing another embodiment of an electro-optical type electronic timepiece according to this invention;

FIG. **6** is a perspective view of other embodiment of an electro-optical type electronic timepiece according to this invention;

FIG. **7** is a vertical section of still further embodiment of an electro-optical type electronic timepiece according to this invention;

FIG. **8** is a vertical section showing still further embodiment of a hand-type electronic timepiece according to this invention; and

FIG. **9** is a plan view showing still further embodiment of a hand-type timepiece according to this invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

FIG. **1** shows a digital type, i.e. electro-optical timepiece of the invention in which reference numeral **2** depicts a windshield and a TWIST liquid crystal display cell **4** as an electro-optical display element underlies the windshield. A printed circuit board **6** underlies the TWIST liquid crystal display cell **4**. Under the printed circuit board there are provided electronic components **8** inclusive of an crystal oscillating element, integrated circuit etc. to drive the TWIST liquid crystal display. A switch actuating member **10** is connected through leading wires **12** to the printed circuit board **6**. A battery cell receiving chamber **14** formed by a battery cell casing **20** is also provided under the printed circuit board **6** in which a trimmer capacitor **16** is secured to the printed circuit board **6**. A partition plate **18** is fitted to the printed circuit board **6** through a partition base **19**. A battery cell cap **24** is threaded into the battery cell casing **20**. A waterproof packing **20** is provided between the battery cell casing **20** and the battery cell cap **24** to insure tight structure. These watch components, i.e. the windshield **2**, the liquid crystal display cell **4**, the printed circuit board **6**, the electronic components **8**, the switch actuating member **10** and the watch casing **20** are wholly cooperated into one by a watch casing **26** made of resin and molded as shown in FIG. **2**.

FIG. **2** is an explanatory diagram to manufacture a wholly electronic timepiece of FIG. **1** in which a split mold **28** consists of an upper half **28***a* and a lower half **28***b*, the upper half **28***a* provided with an opening **32** through which resin is blown into the split mold **28**. Before the blow molding the windshield **2** and the liquid crystal display cell **4** are united into one body by bonding material to prevent resin from coming into any space therebetween.

A conductive rubber **7**, not shown in FIG. **1**, is sandwiched between the printed circuit board **6** and liquid crystal display cell **4** for urging the watch components to the inner faces of the mold halves **28***a*, **28***b* respectively. Therefore the printed circuit board **6** and the liquid crystal display cell **4** is made conductive with each other by strong pressure from the inner face of the split mold **28** through the battery cell casing **20** which is secured to the printed circuit board **6** such that resin does not come into the battery cell casing **20**. Thus there can be easily obtained wholly electronic timepieces with watch casings of various design by changing the shape of the split mold **28**.

In the embodiment of FIG. **1** in which TWIST liquid crystal display cell **4**, preferably resin is blown into the

split mold **28** at room temperature or so since its beat resisting temperature is 70° to 80° C.

FIG. **3** is an amplified view of the battery cell receiving chamber **14** shown in FIG. **1**.

The battery cell receiving chamber **14** is divided into two partitions by the partition plate **18**. In the room adjacent to the printed circuit board **6**, there are provided the trimmer capacitor **16**, an adjustment terminals **34** and detection terminals **36**. As shown in FIG. **1** the battery cell cap **24** is threaded into the battery cell casing **20**. The battery cell cap **24** is taken off and then the partition plate **18** is taken from the battery cell receiving chamber **14** so that there can be effected detection and adjustment of the watch integrated circuit. This structure is advantageous because it is not required to provide another chamber opened toward the outside of the timepiece. In other words, this may obviate the necessity of provision of another casing in lieu of the battery cell receiving casing **20** and another cap to tightly close it and thereby simplifying a timepiece structure to reduce the manufacture cost.

In the other partition of the battery cell receiving chamber **14** there is accomodated the battery cell **38**. The partition plate **18** is provided with a cathode terminal **40** and an anode terminal **42**, each being made of spring material. These terminals **40**, **42** function as a battery cell supports. These are secured to the partition base **19** made of insulation material by means of screws **44**, **46** so as to be connected to conductive member **48**, **50** which make contact with conductive portions **52**, **54** and thereby power being derived from the battery cell **38**. The adjustment terminal **34**, detection terminal **36**, trimmer capacitor **16** and conductive portions **52**, **54** on the printed circuit board **6** are connected to the opposite side of the printed circuit board **7** via through holes. Further conductive patterns on the opposite side of the printed circuit board **6** leads to the integrated circuit. Similarly the electronic components **8** are connected to the conductive pattern via the through holes. This is the reason why direct connections between the interior and exterior of the battery cell receiving chamber **14** are impossible since the battery cell casing **20** is fixed to the printed circuit board **6** by means of screws **55** such that a fixture portion **55***a* of the battery cell casing **20** encroaches upon or lie burried in the printed circuit board **6**. Therefore this structure of fixing the battery cell casing **20** to the printed circuit board **6** insures the fixture of the battery cell casing even when the battery cell cap **24** is put on and off. Strong bonding material may be utilized instead of the screws **55** to fix the battery cell casing **20** to the printed circuit board **6**.

FIG. **4** is an amplified view of the switch actuating member **10** shown in FIG. **1**. The switch actuating member **10** comprises a switch case **56**, a push button **58**, a contact **60**, a spring **62**, switch terminals **64**, **66**, leading wire **68** and a switch base **70**. When the timepiece is assembled in one body by blowing resin into the split mold **28** (FIG. **2**), the switch base **70** and switch case **56** prevent resin from coming in the switch actuating member **10**. Actual switch input operation is effected by pushing the push button **58** and making the contact **60** contact with the switch terminal **64**, **66** to make the switch terminals **64**, **66** conductive with each other.

FIGS. **5A** to **5C** show another embodiment of this invention wherein there is shown an example of a liquid crystal display type watch. According to this embodiment both side faces of a windshield **72** are exposed from the watch while its upper and lower faces as well as its rear face are solidified by molded resin **74**. There are formed on the rear side of the watch recesses **82** in which a battery cell cap **76**, a select switch actuating member **78** and a set switch actuating member **80**. Thus the switch actuating members **78**, **80** are not erroneously operated when one wears the watch. The other structure is similar to that of the watch shown in FIG. **1**. The resin coated portion **74** is further coated with metal and then finished by plating so that there is formed a plated layer **84** as shown in FIG. **5C**.

FIG. **6** shows other embodiment of a liquid crystal display timepiece according to this invention wherein reference numeral **86** illustrares a watch casing frame which is formed by coating of molded resin and further plating with metal. This embodiment enables it to manufacture a watch with special and unique shape only by monstrous cell and windshield.

FIG. **7** shows still other embodiment of a liquid crystal display cell according to this invention wherein provision is made of a movement chamber **90** opened to the exterior of the watch by putting off a back cover **88** therefrom. A packing **92** is sandwiched between the movement chamber **90** and the back cover **88** to prevent water from coming in the movement chamber **90**. The battery cell **38** is received by the movement chamber **90**, and cathode terminal **96** and anode terminal (not shown) are provided in the movement chamber **90**. In this embodiment the trimmer capacitor **16** and the battery cell is arranged without overlap with each other so as to thin the whole thickness of the watch to that extent.

FIG. **8** shows another embodiment of an analogue type, i.e. hand-type electronic timepiece with a second pointer **100**, a minute pointer **101** and an hour pointer **102**. Reference numeral **104** denotes a windshield, and a spacer **105** is interposed between the windshield **104** and a dial **106** for preventing resin from coming in the interior. The dial **106** is mounted on the base plate **107** in a metal case **108**. In the metal case **108**, there are also provided a sweep second cock **109** and a wheel train base **110** as well as wheel trains **111**. Further other components, e.g. a crystal oscillator and a capacitor, not shown are enclosed in the metal case **108**. Of course, these components may be provided outside of the case **108**. The metal case **108** may be exposed outside of the timepiece, but it may be covered with the resin **26**. The metal case **108** may be replaced by a resin case. The wheel train base **110** also functions as a printed circuit board. Reference numeral **112** depicts an insulation ring. As apparent from this embodiment, this invention can be adapted to hand-type timepiece as well as an electro-optical type timepiece.

FIG. **9** shows a hand-type timepiece in which the watch casing made of resin is further plated with metal.

As apparent from the above embodiment this invention provides various useful effects. Namely according to this invention there can be obtained a timepiece light in weight becau e of resin watch casing, thin in thickness because of rational arrangement as a whole, unique in appearance because of no limitation in metal cutting technology and of possibility of coloring. In addition, it is possible to exclude the conventional user's belief that a resin casing is not a high-class article if the resin casing is plated with metal. Of course, it is easy to assemble a timepiece of this invention and its cost can be reduced.

It will thus been seen that the objects set forth above, among those made apparent from the preceding de-

scription, are efficiently attained and, since certain changes may be made in the above composition of matter without departing from the spirit and scope of the invention, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

For example, in the above embodiments, there are described liquid crystal display timepiece as a digital timepiece, but it is easily replaced by other electro-optical display timepiece with light emission diode elements, electrochromic elements etc. And the hand-type timepiece set forth above may be replaced by other analogue type timepieces.

What is claimed is:

1. In an electronic timepiece including a unitary, interconnected structure comprising a windshield, display means adjacent the windshield, timepiece driving means including a time reference signal source for driving the display means, a battery cell case receiving a battery cell supplying the timepiece driving means with driving energy, and external switch means for externally controlling said timepiece driving means and a molded casing made of resin formed about and incorporating into a unit said windshield, said display means, said timepiece driving means, said battery cell case and said external switch means the improvement comprising said timepiece driving means including a printed circuit board carrying the time reference signal source, wherein said display means is sandwiched between the windshield and the printed circuit board, and wherein said battery cell case is adjacent the printed circuit board and has a partition therein forming first chamber for enclosing a trimmer capacitor attached to the printed circuit board and forming a second chamber for receiving the battery cell supplying the timepiece driving means with driving energy.

2. An electronic timepiece as claimed in claim 1 wherein said display means consists of an electro-optical display element.

3. An electronic timepiece as claimed in claim 1 wherein said battery cell case is secured to a printed circuit board of said timepiece driving means by securing means and is provided with a battery cell cap to make exchange of said battery cell possible.

4. An electronic timepiece as claimed in claim 4 wherein said battery cell case is provided with detection and adjustment terminals therein.

5. An electronic timepiece as claimed in claim 1 wherein said external switch means includes a switch case and a switch base for preventing the resin from coming therein.

6. An electronic timepiece as claimed in claim 1 wherein said molded casing is a split molded casing having an opening therein for receiving a blow molded portion formed about and incorporating into a unit said windshield, said display means, said timepiece driving means, said battery cell case and said external switch means.

7. An electronic timepiece as claimed in claim 6 wherein said timepiece driving means includes a printed circuit board carrying the time reference signal source for driving the display means, wherein said printed circuit board is adjacent to and electrically connected to said display means by a conductive rubber.

* * * * *